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PAINT AND VARNISH MATERIALS

A METHOD OF DETERMINING THE ULTIMATE TENSILE STRENGTH, RELATIVE ELONGATION AT RUPTURE, AND MODULUS OF ELASTICITY

EDITED TRANSLATION

FTD-ID(RS)T-1010-79 23 August 1979

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PAINT AND VARNISH MATERIALS. A METHOD OF DETERMINING THE ULTIMATE TENSILE STRENGTH, RELATIVE ELONGATION AT RUPTURE, AND MODULUS OF ELASTICITY

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*<u>ye</u> initially, after vowels, and after ъ, ь; <u>e</u> elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

PAINT AND VARNISH MATERIALS
GOST 18299-72

A Method of Determining the Ultimate Tensile Strength, Relative Elongation at Rupture, and Modulus of Elasticity

This standard is extended to paint and varnish materials and establishes a method of determining stress-strain properties of a free paint and varnish film:

ultimate tensile strength;

relative elongation at rupture and modulus of elasticity.

Tensile strength is a property of a film to resist mechanical failure which occurs as a result of the effect of external tensile forces directed perpendicular to a cross section of the sample.

Ultimate tensile strength is the maximum stress which the sample can withstand without rupturing.

Relative elongation at rupture is the ability of a film to change the original length in tension under the effect of external forces up to rupture.

Modulus of elasticity in tension characterizes the degree of rigidity of the material.

1. ESSENCE OF THE METHOD

1.1. The essence of the method involves the testing of samples of a free paint and varnish film in tension under the effect of uniformly increasing load to the rupture of the film, upon which the following are determined:

a) ultimate tensile strength in kg/cm^2 - the ratio of rupture stress to the initial area of the samples cross section.

b) relative elongation at rupture in percentage - the ratio of elongation of the film's working part, measured at the moment of its rupture, to the initial length of the film's working part.

c) modulus of elasticity in kg/cm^2 - the ratio of stress to the conforming relative elongation within the limits of proportionality.

2. APPARATUS AND MATERIALS

2.1. The test is conducted on a tensile-testing machine of the RPU-0.05T type or the MRS-250 type.

The use of any tensile-testing or general-purpose machine which satisfies the following requirements is allowed:

the load scale should be from 0 to 50 kg with a scale division of 0.05 kg within the limits of measuring loads to 25 kg, and 0.1 kg for loads above 25 kg;

controlled speed of the clamps' separation should include a value of 20 mm/min;

it should have a device for graphic recording of load and deformation with a scale of recording not less than 10:1.

Note. The use of tensile-testing machines of the RZM-30 type, which have a rate of strain of 50 mm/min and a device for measuring strain with the scale division not larger than 1 mm or hand measuring of strain is allowed for testing enamel and varnish films for leather.

2.2 A thickness gage indicator with scale division 0.002 mm.

A metal template with a dimension of 10 x 30 mm.

Razor blades.

Sandpaper with a grain size from No. 3 to No. 5 (GOST 6456-68).

Glue BF-2.

3. PREPARATION FOR THE TEST

3.1. Free paint and varnish films are obtained according to GOST 14243-69.

The film's thickness and aging time before the test are determined in agreement with the requirements of standards or other technical documentation on paint and varnish materials.

3.2. The test samples with dimensions of 10 x 30 mm are cut out from the free paint and varnish film with a razor blade along the template or metal ruler, having left a margin of at least 10 mm from its edge.

Samples are allowed to be cut out with the aid of a stamp, the pattern and dimensions of which are shown in Appendix 1.

Allowable deviations of the sample's dimensions in length and width should not be more than ±0.1 mm.

The length of the sample's working part should be 10 mm.

3.3. The thickness of the sample's film is determined by a thickness gage indicator and is calculated as the arithmetic mean of three determinations, conducted in succession on various sections of the sample.

Allowable deviations of the sample's thickness from the mean value are not more than ±5%.

3.4. To eliminate failure and the sample's slipping out of the clamps of the tensile-testing machine, it is recommended that sandpaper with dimensions corresponding to the size of the clamps be glued to the interior surface of the clamps.

4. CONDUCTING THE TEST

4.1. The tests are conducted at 20 ±2°C and a relative air humidity of 65 ±5%.

4.2. The film sample is fastened in the clamps of the tensile-testing machine, so that the longitudinal axis is arranged in the direction of tension and applied forces act along the whole width of the sample.

Deformation of the sample when clamping it in the clamps of the tensile-testing machine is not admissible.

It is recommended that an attachment (see Appendix 2) be used when fastening a sample in the clamps of the tensile-testing machine.

4.3 The test is conducted when the separation speed of the clamps is 20 mm/min if there are no corresponding instructions in standards or another technical document on tested materials.

4.4 Stress and elongation at rupture of those samples, the rupture of which occurred in the center of the working part, are taken into account in the process of testing.

4.5. Values of ultimate tensile strength, modulus of elasticity, and relative elongation at rupture, which are determined at different rates of strain, are incomparable.

5. PROCESSING OF RESULTS

5.1. Calculation is conducted on test results of at least five parallel samples.

5.2. Ultimate tensile strength for each sample (σ_i) in kg/cm^2 is calculated by the formula

$$\sigma_i = \frac{P_i}{D_i H_i} 100,$$

where

P_i is the load at the rupture for each sample in kg;
D_i is the mean value of thickness of each sample in mm;
H_i is the width of each sample in mm.

5.3. The increase of the length of the sample's working part (Δl) is measured by the "stress-strain" diagram with consideration of the scale of the record.

5.4. Relative elongation at rupture of each sample (L_i) in percent is calculated by the formula

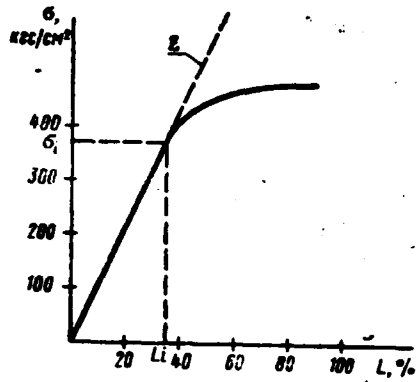
$$L_i = \frac{\Delta l_i}{l_0 K} 100,$$

where Δl_i is the increase of the length of each sample's working part in millimeters; l_0 is the initial length of each sample's working part in millimeters; K is the scale factor.

5.5. The modulus of elasticity is calculated by the "stress-strain" diagram along the angle of the slope to the abscissa axis of the tangent (Z) carried out to the initial rectilinear section of the diagram.

The modulus of elasticity for each sample (E_i) in kg/cm^2 is calculated by the formula

$$E_i = \frac{\sigma_i}{L_i} 100.$$



"Stress-strain" diagram.
KEY: (1) kg/cm^2.

5.6. The mean arithmetic value of ultimate tensile strength ($\bar{\sigma}$) and the value of the root-mean-square deviation ($\bar{S}$), calculated by formals

$$\bar{\sigma} = \frac{\Sigma\sigma_i}{N}; \quad \bar{S} = \sqrt{\frac{\Sigma(\bar{\sigma}-\sigma_i)^2}{N(N-1)}}.$$

where N is the number of samples, are taken as test results.

The allowable deviation of separate values should not exceed the confidence limit

$$\bar{\sigma} \pm 2{,}78\bar{S} \text{ with } N=5 \text{ and } \alpha=0{,}95,$$

where α is the coefficient of reliability.

Relative error (ξ) in percent is calculated by the formula

$$\xi = \frac{2.78\ \bar{S}}{\bar{\sigma}}.$$

The allowable value (ξ) should not exceed 10%.

5.7. The mean arithmetic value of relative elongation at rupture ($\bar{L}$) and the value of the root-mean-square deviation ($\bar{S}_1$), which are calculated by formulas

$$\bar{L}=\frac{\Sigma L_i}{N}; \qquad \bar{S}_1=\sqrt{\frac{\Sigma(\bar{L}-L_i)^2}{N(N-1)}}.$$

are taken as test results.

The allowable deviation of separate values should not exceed the confidence limit

$$\bar{L}\pm 2{,}78\bar{S} \text{ with } N=5 \text{ and } \alpha=0{,}95.$$

5.8. The mean ari ımetic value of the modulus of elasticity ($\bar{E}$) and the value of tł root-mean-square deviation ($\bar{S}_2$), which are calculated by the formulas are taken as the test result.

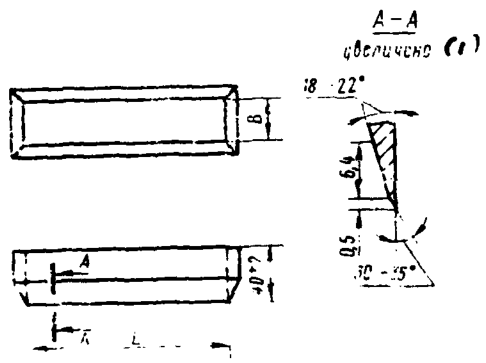
$$\bar{E}=\frac{\Sigma E_i}{N}; \qquad \bar{S}_2=\sqrt{\frac{\Sigma(\bar{E}-E_i)^2}{N(N-1)}}.$$

The allowable deviation of separate values should not exceed the confidence limit

$$\bar{E}\pm 2{,}78\bar{S}_2 \quad \text{with } N=5 \text{ and } \alpha=0{,}95.$$

APPENDIX 1 to GOST 18299-72

SHAPE AND DIMENSIONS OF THE STAMP FOR CUTTING SAMPLES FROM FREE PAINT AND VARNISH



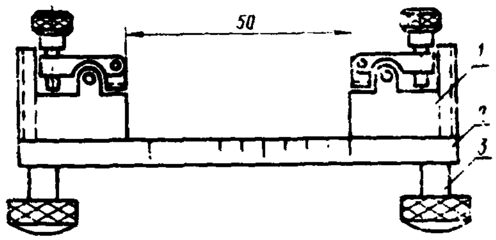
L—30 ± 0,1 мм.

The cutting edges of the stamp should be sharp as shown in the sketch, and should not be damaged.

KEY: (1) Magnified

APPENDIX 2 to GOST 18299-72

AN ATTACHMENT TO THE CLAMPS OF THE TENSILE-TESTING MACHINE FOR SECURING THE SAMPLES



The attachment was developed by the State Scientific Research and Planning Institute of the Paint and Varnish Industry (GIPILKP).

KEY: (1) Clamps for the sample; (2) Mounting plank; (3) Screws.

Screws together with the clamps can move freely along the mounting plank. The marks drawn on the plank allow required dimensions of the sample's working part to be set accurately.

A change in the attachment's dimensions in accordance with the design features of the tensile-testing machine is permitted.

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